ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 01, 2024

Type of manuscript: Original Article (Research paper)

Exploring the risk of Tuberculosis in household contacts of pediatric age group

Dr. Raghuraj Singh Rajpoot[1], Dr. Rajesh Tikkas[2], Dr. Shipra Mandraha[3], Dr. Lokendra Dave[4]

Affiliation:

1: Postgraduate Resident Department of Pediatrics, Gandhi Medical College, Bhopal, Madhya Pradesh

2: Professor Department of Pediatrics, Gandhi Medical College, Bhopal, Madhya Pradesh

3: Assistant Professor, Department of Pediatrics, Gandhi Medical College, Bhopal, Madhya Pradesh

4: Professor and Head, Department of Respiratory medicine, Gandhi Medical College, Bhopal, Madhya Pradesh

Correspondence: Dr. Shipra Mandraha, Assistant Professor, Department of Pediatrics, Gandhi Medical College, Bhopal, Madhya Pradesh, PIN-462001

Mob no: 9407852767, **Email ID:** drshipra191@gmail.com

Institution: Gandhi Medical College, Bhopal, Madhya Pradesh

Conflict of interest: None stated

Ethical clearance: The approval was obtained from the Institutional Ethics Committee of the Gandhi Medical College, Bhopal, Madhya Pradesh (Letter no.27159/MC/IEC/2021 Dated 25/08/21)

ABSTRACT

Background: Pediatric tuberculosis (TB) is a primary cause of death and morbidity. Children living in the houses of adults with tuberculosis are at high risk of infection and disease; household contact investigations are one of the most effective way for finding children with TB infection and disease. **Aims and Objective**: Present study was performed to find the occurrence and factors responsible for the development of tubercular infection in the pediatric population {aged 0-12 years) in a household contact of newly Diagnosed tuberculosis cases. **Materials and Methods**: Two hundred and fifty-four children who had household contact were studied in the Department of Pediatrics of a tertiary care center, from March 2021 to September 2022. In addition, to complete clinical history and clinical examination, data were made in baseline investigation such as tuberculin skin testing, sputum acid-fast bacillus; chest X-ray and CBNAAT was performed on all household contacts of age group 0-12 years. Results: The incidence of child TB was 5.9% (n=15 out of 254). The incidence of infection (assessed by the Mantoux test) was 20.9%. Reactive Mantoux test (100%) and positive Sputum for AFB test (66.7%), Malnourishment (93.3%), and smokers in the family (60%) were the significant risk factors associated with child tuberculosis. Most of the index source cases diagnosed with tuberculosis were female (66.7%; p=0.075) and had pulmonary tuberculosis (60%; p=0.008). The majority of the children with TB completed treatment (80%). **Conclusion:** Tuberculosis

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 01, 2024

infection and clinical disease are more common in children in households with adult patients than in the general population. That contact with sputum-positive adults increases the risk significantly.

Keywords: Pediatric Tuberculosis, Household contacts, Contact Tracing, NTEP

Introduction

Pediatric tuberculosis (TB) is a primary cause of death and morbidity. According to WHO TB figures for 2019, there were 10.0 million cases of TB worldwide, with about 10% (1 million) of those under the age of 15 years (1). The World Health Organization (WHO) defines childhood tuberculosis as infection with Mycobacterium tuberculosis in children aged 0–14 years. In smear-positive pulmonary TB, the infection is acquired through inhaling aerosol droplets containing bacilli expectorated by an active TB patient. As a result, the risk of infection increases when children are household contacts of TB sufferers (2). Household contact is defined as "a person or group of people, related or unrelated to each other, who live together in the same living unit and share a similar source of food" in TB contact tracing programs (3). Younger children are more likely to have serious tuberculosis infections, such as tuberculous meningitis, which can be deadly or have long-term consequences (e.g., neurological deficits). These deaths and their long-term repercussions significantly impact families and society; otherwise, these young children would have had decades of productive life ahead of them (4). More children with tuberculosis must be recognised and treated or prevented from becoming sick with tuberculosis in the first place to minimize the burden of paediatric tuberculosis sickness and death. Preventing tuberculosis cases is especially crucial in resource-limited situations, where diagnosing tuberculosis in children can be difficult (4). Because children living in the homes of adults with tuberculosis are at high risk of infection and disease, household contact investigations are one of the most effective techniques for finding children with tuberculosis infection and disease (5). Until now, few studies have been conducted to determine the prevalence of tuberculosis infection among Pediatric age groups in close contact with a newly diagnosed tuberculosis patient. As a result, the current study was done to determine the prevalence of tuberculosis infection in the pediatric age group in a household contact of newly diagnosed tuberculosis patient.

Materials and Methods

A prospective cross-sectional study was performed on 254 children who had household contact of tuberculosis in the tertiary care center of central India from March 2021 to September 2022.

For this study, household contact was defined as an individual who had resided in the household for at least 7 consecutive days during the 3 months before the diagnosis of tuberculosis in the index case of pediatric age group 0-12 years. Household contacts who were already diagnosed with TB infection/disease and taking ATT (Anti Tubercular Therapy) were excluded.

Informed written consent of parents/guardians of cases was taken before commencing the study.

The study recruited sputum smear-positive pulmonary tuberculosis cases having one or more household contacts living with them. Demographic details and other details were filled in the prescribed performed proforma. Complete clinical history was taken and clinical examination

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 01, 2024

was done in all the children. Baseline investigations including Tuberculin skin testing, sputum AFB (Acid Fast Bacilli), Chest X-ray, CBNAAT (Cartridge based Nucleic Acid Amplification Test) was performed on all household contacts of age group 0-12 years to rule out active tuberculosis in them.

Household contacts were asked about history of persistent fever >2 weeks, unremitting cough for >2 weeks, weight loss of 5% or no weight gain in Past 3 months.

Chest radiograph was done in all the children as a part of initial screening tool. Lesions highly suggestive of TB include military pattern, chronic fibrocavitary lesions and hilar/ paratracheal lymph nodes.

The children were then subjected to NTEP (Nation Tuberculosis Elimination Program) approved rapid molecular tests i.e. nucleic acid amplification tests (NAAT) on sputum sample or gastric aspirate specimen to detect the presence of Mycobacterium tuberculosis. For this, 2-5 ml of self expectorated sputum sample was collected in sterile container and tested for TB. In young children who were unable to produce sputum, 10-15 ml of gastric aspirate was obtained using nasogastric tube after a fasting period of 4-6 hours.

Demonstration of Acid fast bacillus (AFB) on smear microscopy or culture or by molecular tests is the gold standard of TB diagnosis. If NAAT positive, child was treated as a case of microbiologically confirmed case of TB and started on Anti Tubercular Treatment (ATT) as per the National Tuberculosis Elimination Programme (2022).(6)

Statistical Analysis

Data were recorded in the Microsoft Excel program, and statistical analysis was performed by the SPSS program for Windows, version 25 (SPSS, Chicago, Illinois). Data were presented as absolute numbers and percentages. Cross tabulation was done to obtain the relationship between various parameters and child TB status. Categorical variables were analyzed using the chi-square test or Fisher's exact test. $P<0.05$ was considered statistically significant.

Results

Present study was conducted on a total of 254 pediatrics cases aged 0-12 years, who were household contacts of 103 newly diagnosed Tuberculosis index cases. The study was conducted at the department of pediatrics of a medical college in central India and associated TB hospital and DOTS centre in the nearby community.

The incidence of Pediatric TB was 5.9% (n=15 out of 254) among the household contacts with Tuberculosis. The incidence of infection (assessed by the Mantoux test) was 20.9%. The majority of the child with TB were older (9.33±2.46 years; p=0.034), were female (53.35%) than males (46.7%; p=0.348), and belonged to an urban area (73.3) than rural area (26.7%; p=0.285). (Table 1)

The majority of mothers had education till primary (53.3%) class, 20% had high school education, and another 20% were graduates (p=0.922), were laborers (60%), only 26.7% were doing business, and 13.3% were in private jobs (p=0.485).

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 01, 2024

The most common presenting complaints were decreased appetite (66.7%) and weight loss (60%), followed by cough (53.3%) and fever (53.3%). Other least common presenting complaints were abdominal pain (13.3%), chest pain (13.3%), and Lymph node swelling in the neck (6.7%). The distribution was significant, with a p-value of <0.001.

Out of 15 children with TB, the majority of the family members were using LPG (86.7%) as cooking fuel, whereas only 2 were using LPG with wood as the fuel. However, the distribution was insignificant, with a p-value of 0.471.

Most vaccination was completed for age (66.7%), whereas in 5 (33.3%), it was partially done. The distribution was significant, with a p-value of 0.007. The majority of the family of children with TB had more than 4 members (86.7%). However, the distribution was insignificant, with a p-value of 0.083. In the majority of the children with TB, Isoniazid prophylaxis was given. The distribution was significant, with a p-value of <0.001. (Table 2)

Most of the children diagnosed with tuberculosis were female (66.7%; p=0.075) and had pulmonary tuberculosis (60%; p=0.008). The majority of the children with TB completed treatment (80%).

Table 1: Characteristics of study subjects in household contact with tuberculosis

Parameters		TB Disease		Total	P value
		No	Yes		
Sex	Female	103 (43.1)	10 (66.7)	113 (44.5)	0.075
	Male	136 (56.9)	5 (33.3)	141 (55.5)	
Type of TB	Extra Pulmonary	75 (31.4)	6 (40)	81 (31.9)	0.008
	Pulmonary	164 (68.6)	9 (60)	173 (68.1)	
Sputum status of parent	Negative	165 (69)	8 (53.3)	173 (68.1)	0.206
	Positive	74 (31)	7 (46.7)	81 (31.9)	

Table 2: Comparing significant parameters associated with the TB disease

Parameters		TB Disease		Total	P value
		No	Yes		
Mantoux Test	Non-Reactive	201 (84.1)	0 (0)	201 (79.1)	<0.001
	Reactive	38 (15.9)	15 (100)	53 (20.9)	
Sputum for AFB test	Negative	206 (86.2)	5 (33.3)	211 (83.1)	<0.001
	Positive	0 (0)	10 (66.7)	10 (3.9)	
	Not Done	33 (13.8)	0 (0)	33 (13)	
Chest X-Ray	Not Done	93 (38.9)	0 (0)	93 (36.6)	<0.001
	Not Suggestive	146 (61.1)	2 (13.3)	148 (58.3)	
	Suggestive	0 (0)	13 (86.7)	13 (5.1)	
CB NAAT	Not done	224 (93.7)	10 (66.7)	234 (92.1)	<0.001

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 01, 2024

	Negative	15 (6.3)	3 (20)	18 (17.1)	
	Positive	0 (0)	2 (13.3)	2 (0.8)	
BCG Scar	Absent	12 (5)	7 (46.7)	19 (7.5)	<0.001
	Present	227 (95)	8 (53.3)	235 (92.5)	
Malnourishment	No	227 (95)	1 (6.7)	228 (89.8)	<0.001
	Yes	12 (5)	14 (93.3)	26 (10.2)	
Smokers in family	No	166 (69.5)	6 (40)	172 (67.7)	0.018
	Yes	73 (30.5)	9 (60)	82 (32.3)	
HIV Positive	No	239 (100)	13 (86.7)	252 (99.2)	<0.001
	Yes	0 (0)	2 (13.3)	2 (0.8)	
Vaccination	Completed	216 (90.4)	10 (66.7)	226 (89)	0.007
	Partially completed	20 (8.4)	5 (33.3)	25 (9.8)	
	Not Done	3 (1.3)	0 (0)	3 (1.2)	
Isoniazid prophylaxis	Not given	177 (74.1)	3 (20)	180 (70.9)	<0.001
	Given	62 (25.9)	12 (80)	74 (29.1)	

Discussion

TB disease in children under 15 years of age (also called pediatric tuberculosis) is a public health problem of special significance because it is a marker for the recent transmission of TB. (7) Also, of special significance, infants and young children are more likely than older children and adults to develop life-threatening forms of TB disease (e.g., disseminated TB, TB meningitis). Among children, the greatest number of TB cases are seen in children younger than 5 years of age and adolescents older than 10. (7) The infection is almost mainly transmitted through the air from patients with pulmonary disease. The risk of transmission is more if the index case is ‘‘sputum smear positive’’, and is directly proportional to the bacillary density in respiratory secretions. Therefore, proximity and persistence of contact are major determinants of the risk of transmission of infection, and those living within the same household are at higher risk than general contacts.

The present study was conducted on a total of 254 pediatric cases who were household contacts of 103 newly Diagnosed tuberculosis index cases. Out of 254 pediatric cases, 15 (5.9%) had TB. The incidence of TB disease among the pediatric case in the present study centre was 5.9%. Children of tuberculosis were significantly older (9.33±2.46 years) with a p-value of 0.034 compared to children not having disease.

In the present study incidence of child TB and infection was 5.9% and 20.9%, respectively. Sinfield R et al. studied 195 children aged 5 and up who were contacts of 161 source cases and reported a high prevalence of tuberculosis infection and illness (45 percent and 23 percent, respectively). (8) A study by Jaganath et al. from Uganda, who examined 761 child contacts aged 15 years, reported higher rates of tuberculosis in children (10%). (9)

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 01, 2024

The majority of the child with TB was young, was female, and belonged to urban areas. In a similar study by Singh M et al., who studied 200 consecutive adults with pulmonary tuberculosis in their homes, reported that younger age, severe malnutrition, lack of BCG vaccination, contact with an adult who was sputum positive, and exposure to tobacco smoke in the environment were all critical risk factors for infection transmission which is in line with present study findings. (10) A study from South East Asia by Triasih R et al. enrolled 11 heterogeneity studies and reported that the frequency of tuberculosis infection was greater among child contacts under 15 years of age (24.4–69.2%) compared to the prevalence of tuberculosis disease, which ranged from 3.3 percent to 5.5 percent. (11)

Mantoux Test was positive in all the children with TB; in agreement with this, Sharma et al. evaluated the parameters related to tuberculosis transmission and calculated the prevalence of TB infection among under five-year-old children in household contact with pulmonary tuberculosis patients reported that Mantoux was found to be positive in 13.7 % of 190 home contacts. (12)

A study by Jaganath et al. fromUganda also reported no incidences of disseminated tuberculosis, and 99% who began isoniazid treatment did not acquire the disease. (9) in line with that, in the present study, isoniazid prophylaxis was given to almost all child TB cases. Martinez et al. reported that preventive therapy was beneficial in 63 percent of all exposed children and 85 percent of those with a positive infection test. (13)

Risk variables included HIV status, malnourishment, smokers in the family, and a baseline positive tuberculin skin test. In line with that, a study from Lucknow district of Uttar Pradesh where the author included 200 family children (1-15 years) of sputum positive patients registered at DOTS clinics reported that age >6 years, duration of stay with index case >10 hours/day, and malnutrition were all related to tuberculosis infection in children. (14)

Reports by Martinez et al. showed that from 0 to 5 years of age (n=137,647) exposed children, the risk of tuberculosis among infected children who did not receive preventative therapy was 19.0 percent. (13)

Most of the index source cases diagnosed with tuberculosis were female and had pulmonary tuberculosis. In line with these findings, Sinfield R et al. studied 195 children aged 5 and up who were contacts of 161 source cases and reported that with increasing smear-positivity of the source case, as well as if the source case was female, the risk of a kid becoming infected increased dramatically. (8) Batra et al. reported that for most of the children, the source case was a female (66.1%), and 73.6% of people had pulmonary disease. (15) This highlight that adult index characteristics like sex, HIV status, and disease extent or severity were linked to childhood disease.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 01, 2024

Conclusion

Tuberculosis infection and clinical disease are more common in children in households with adult patients than in the general population. That contact with sputum-positive adults increases the risk significantly. Female children are more vulnerable than male children, and mothers play a significant role in disease transmission, highlighting the need for a greater focus on females in TB control initiatives. HIV status, malnourishment, smokers in the family, and a baseline positive tuberculin skin tests are the significant risk factor to spear the infection. BCG vaccination is highly protective, especially among children aged 5 years. Tuberculosis infection in children is linked to several factors, including the index case, susceptible host, and environment, all of which may be controlled to avoid TB infection in children. Contact tracing in the community is an important aspect of Tuberculosis Preventive Therapy which will be helpful in eliminating TB from India.

References

1. Global Tuberculosis report. Geneva: WHO; 2019. Accessed on 23 March 2022 from URL: https:// apps.who.int/iris/bitstream/handle/10665/329368/9789241565714-eng. pdf?ua=1.
2. World Health Organization (WHO). Childhood TB Training Toolkit. 2014. Available from: http://apps.who.int/iris/bitstream/handle/10665/134387/9789241507783_eng.pdf?sequence=1.
3. Szkwarko D, Hirsch-Moverman Y, Du Plessis L, Du Preez K, Carr C, Mandalakas AM. Child contact management in high tuberculosis burden countries: a mixed-methods systematic review. PLoS One. 2017;12(8):1–24.
4. Chiang SS, Khan FA, Milstein MB. Treatment outcomes of childhood tuberculous meningitis: a systematic review and meta-analysis. Lancet Infect Dis, 14 (2014), pp. 947-957.
5. Fox GJ, Barry SE, Britton WJ, Marks GB. Contact investigation for tuberculosis: a systematic review and meta-analysis Eur Respir J, 41 (2013), pp. 140-156.
6. National Tuberculosis Elimination Programme (2022). Pediatric TB Management Guideline 2022. (online). Available from https://tbcindia.gov.in/showfile.php?lid=3668. Last accessed July 2023.
7. Ghanaie RM, Karimi A, Azimi L, James S, Nasehi M, Mishkar AP, Sheikhi M, Fallah F, Tabatabaei SR and Hoseini-Alfatemi SM. Diagnosis of latent tuberculosis infection among pediatric household contacts of Iranian tuberculosis cases using tuberculin skin test, IFN- γ release assay, and IFN-γinduced protein-10. BMC Pediatrics (2021) 21:76.
8. Sinfield R, Nyirenda M, Haves S, Molyneux EM, Graham SM (2006) Risk factors for TB infection and disease in young childhood contacts in Malawi. Ann Trop Paediatr 26: 205–213.
9. Jaganath D, Zalwango S, Okware B, et al. Contact investigation for active tuberculosis among child contacts in Uganda. Clin Infect Dis. 2013;57(12):1685-1692.

ISSN: 0975-3583, 0976-2833 VOL15, ISSUE 01, 2024

10. Singh M, Mynak ML, Kumar L, Mathew JL, Jindal SK. Prevalence and risk factors for transmission of infection among children in household contact with adults having pulmonary tuberculosis. Archives of disease in childhood, 2005; 90(6), 624–628.
11. Triasih R, Rutherford M, Lestari T, Utarini A, Robertson CF, Graham SM. Contact investigation of children exposed to tuberculosis in South East Asia: a systematic 283 review. J Trop Med. 2012; h.
12. Sharma KR, Bhatta NK, Niraula SR, Gurung R, Pokharel PK. A Measure of Transmission of Tuberculosis Infection among Children in Household Contact. SAARC Journal of Tuberculosis, Lung Diseases & HIV/AIDS,2018; XVI(1).
13. Martinez L, Cords O, Horsburgh CR, Andrews JR, & Pediatric TB Contact Studies Consortium. The risk of tuberculosis in children after close exposure: a systematic review and individual-participant meta-analysis. Lancet (London, England), 2020; 395(10228), 973–984.
14. Mishra S, Singh SK, Mohan U; Sahu R, Verma AV; Srivastava VK. Risk Factors Associated with Tuberculosis Infection Among Household Children Contacts of Sputum Smear Positive Tuberculosis Cases. Indian J Comm Health. 2017;29, 2: 162-167.
15. Batra S, Ayaz A, Murtaza A, Ahmad S, Hasan R, Pfau R. Childhood tuberculosis in household contacts of newly diagnosed TB patients. PLoS One. 2012;7(7):e40880.